Dhofar 1180

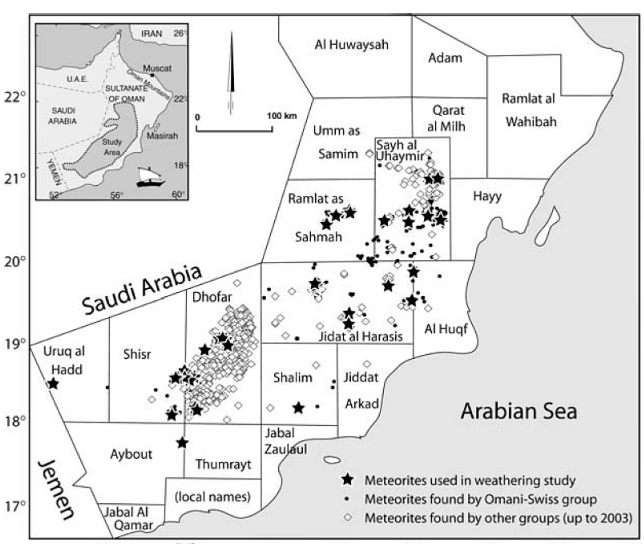
Polymict regolith breccia

115 g

Figure 1: Dhofar 1180 illustrating dark glassy matrix and light colored feldspathic clasts. Image from M. Farmer. Width of sample is 8 cm.

Introduction

Dhofar 1180 (Fig. 1) was found in the Dhofar region of Oman in January 2005 (Figs. 2 and 3). The meteorite has an external shape similar to a "thick-bladed talon" (Connolly et al., in preparation). The sample is a polymict regolith breccia that contains a variety of lithologies set in a matrix of similar materials with a preferred orientation of fragments and clasts (Fig. 4).



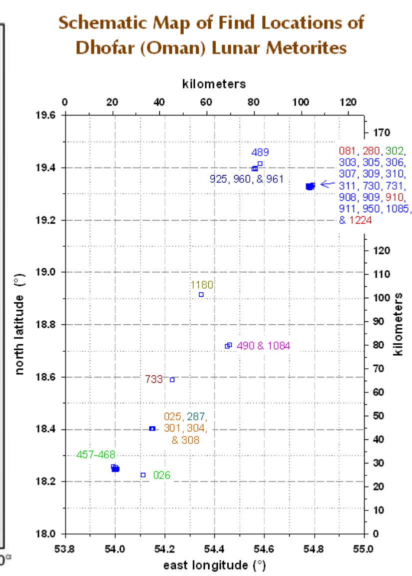


Figure 2 and 3: Location maps of the Dhofar region in Oman (from Al-Kathiri et al., 2005) and the specific coordinates for Dhofar 1180 (near center).

Petrography and mineralogy

Clasts (0.1 to 1 mm) in this meteorite are mostly ferroan anorthosites (Fa_{38}; $Fs_{38.6}Wo_{2.1}$) as well as gabbroic anorthosites, anorthositic gabbros, norites (Fa_{18}), troctolites, olivine gabbros ($Fa_{36.8}$; $Fs_{33.4}Wo_{4.3}$), microporphyritic and fine-grained impact melt breccias, and rare, ophitic/subophitic basalts (pyroxene core - $Fs_{40}Wo_{11.8}$, rim - $Fs_{69.1}Wo_{15.8}$) (Connolly et al., 2006; Bunch et al., 2006; Zhang and Hsu, 2006, 2007, 2009). Zhang and Hsu (2007, 2009) describe one KREEP related clast, although this component must be minor because the bulk chemistry of Dho1180 is not particularly KREEPy (see below). The plagioclase feldspar varies in composition from An_{91-99}, and the matrix contains numerous fragments of plagioclase, pyroxene, and olivine (Fig. 4 and 5). In addition to the wide variety of clasts (Zhang and Hsu, 2009), there are also a number of glassy fragments in Dho 1180 (Fig. 6), making it a regolith breccias as opposed to simply a fragmental breccias (Zhang and Hsu, 2009).

Figure 4: Cut slab face of Dhofar 1180 illustrating dark glassy matrix and light colored feldspathic clast. Image from M. Farmer. Width of sample is 10 cm.

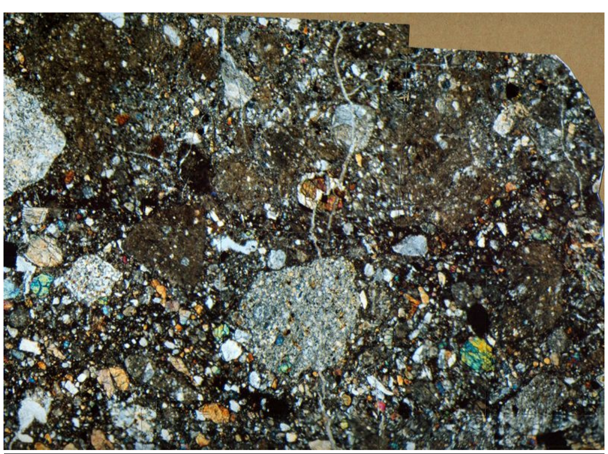


Figure 5: Thin section image of Dhofar 1180. Image from T. Bunch and T. Irving. Field of view is 5 mm.

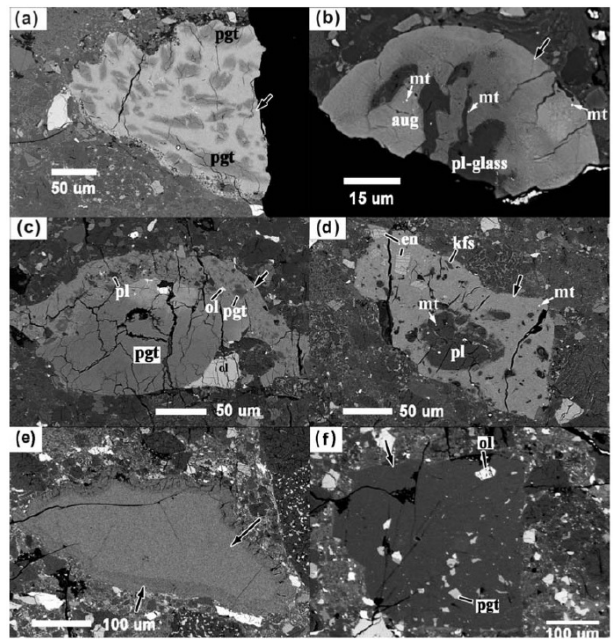


Figure 6: BSE images of glasses in Dhofar 1180. a) A mafic glass including some anhedral-subhedral pigeonite grains. b) A mafic glass with a near-circular outline. This glass includes a relict augite grain and plagioclase glass. The glass portion shows devitrification. Some very finegrained metal grains exist in this glass. c) A mafic glass that is attached to a pyroxene grain. d) A mafic glass containing some plagioclase grains, and fragments of exsolved enstatite and K-rich feldspar. Some very fine-grained metal grains exist in this glass. e) A feldspathic glass showing devitrification at the margin. Arrows indicate glass regions. pgt=pigeonite; aug=augite; ol=olivine; pl=plagioclase; kfs=K-rich feldspar; en=enstatite; mt=metal. [from Zhang and Hsu, 2009].

Chemistry

Preliminary compositional data for this meteorite, showed it to have 22.6 wt% Al_2O_3, 9.3 wt% FeO, 0.9 ppm Th (Bunch et al., 2006), 26.8 ppm Sc, 1040 ppm Cr, 130 ppm Ni, and 2.84 ppm Eu (Korotev et al., 2008). These traits alone demonstrate that it is a mixed breccia that includes both basaltic and highlands materials, but no KREEP. Additional studies have sharpened the understanding of the unique nature of this meteorite. It has lower REE contents than many polymict breccias (Fig. 7). In addition, it overlaps somewhat, but is nonetheless distinct from other polymict lunar meteorite breccias in alkali, Sc and Sm contents, such as the YQN samples and NWA 5153 and 5207 (Fig. 8).

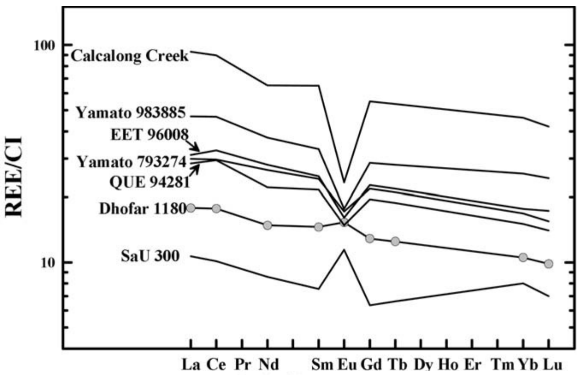


Figure 7: CI-normalized (Anders and Grevesse 1989) REE abundances of Dhofar 1180 and some lunar meteorites (from Zhang and Hsu, 2009).

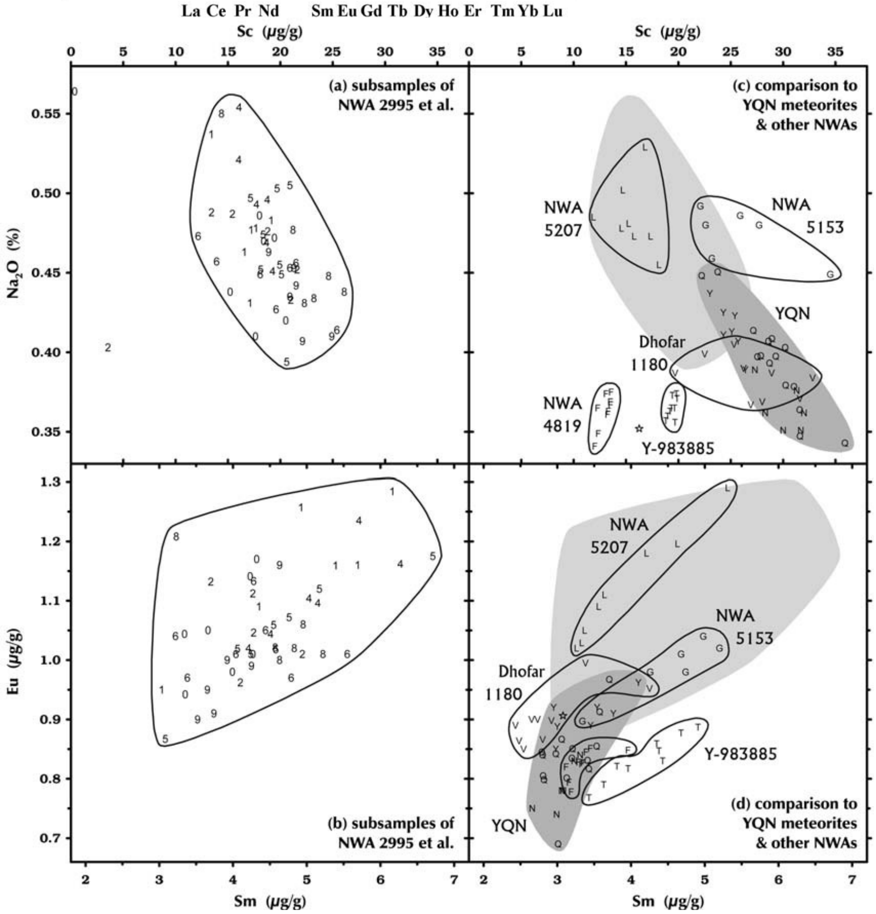


Figure 8: Comparison of Dho 1180 bulk composition to other polymict lunar meteorite breccias, illustrating its distinct composition with slightly higher Eu, lower Sc compared to the YQN pairing group (Yamato, QUE, NWA 2995 pairs; Korotev et al., 2009b).

Table 1a:Chemical composition of Dho 1180

reference	1	1	2
weight	20-60	196	91.19 mg
technique	a	c	*c*
SiO_2 %	45.4		
TiO_2	0.71		
Al_2O_3	22.6		
FeO	9.22		
MnO	0.15		
MgO	6.17		
CaO	14.9		
Na_2O	0.36		
K_2O	0.06		
P_2O_5	0.05		
S %			
sum	99.7		
Sc ppm		26.8	15.53
V			
Cr		1040	869
Co		18.6	15.68
Ni		128	112
Cu			
Zn			
Ga			
Ge			
As		0.35	
Se		n.a.	
Rb		<8	
Sr		1580	1973
Y			
Zr		75	47
Nb			
Mo			
Ru			
Rh			
Pd ppb			
Ag ppb			
Cd ppb			
In ppb			
Sn ppb			
Sb ppb			
Te ppb			
Cs ppm		<0.2	0.052
Ba		537	594
La		5.3	4.18
Ce		14.1	10.67
Pr			
Nd		8.9	6.7
Sm		2.84	2.14
Eu		0.9	0.856
Gd			
Tb		0.64	0.453
Dy			
Ho			
Er			
Tm			
Yb		2.44	1.711
Lu		0.345	0.239
Hf		2.18	1.55
Ta		0.3	0.213
W ppb			
Re ppb			
Os ppb			
Ir ppb		5.3	3.6
Pt ppb			
Au ppb		1.5	10.1
Th ppm		0.9	0.696
U ppm		0.32	0.37

technique (a) EMPA, (b) ICP-MS, (c) INAA (d) XRF

Table 1b. Light and/or volatile elements for Dho 1180

Li ppm	
Be	
C	
S	
F ppm	
Cl	
Br	0.53
I	
Pb ppm	
Hg ppb	
Tl	
Bi	

References: 1) Korotev et al. (2009b); 2) Zhang and Hsu (2009)

Radiometric age dating

There are no known studies.

Cosmogenic exposure ages

There are no known studies.